SECTION 236500 - COOLING TOWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Open-circuit, induced-draft, cross-flow cooling towers.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Cooling towers shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.

1.3 SUBMITTALS

A. Product Data: For each model indicated, provide rated capacities at design conditions, pressure drop, fan performance data, physical dimensions, required clearances, weights, sizes and locations of field connections, electrical requirements, and accessories.

B. Seismic Qualification Certificates: For cooling towers, accessories, and components, from manufacturers.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Operation and maintenance data.

D. Warranty.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. ASHRAE/IESNA 90.1 for energy efficiency.

C. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:

1. Fan assembly including supports, fan, drive, and motor.
2. Fan shafts, bearings and sleeves.
4. Tube bundle.
5. External-circuit circulating pump.
6. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OPEN-CIRCUIT, INDUCED-DRAFT, CROSSFLOW COOLING TOWERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

2. Evapco Inc.

B. Fabricate cooling tower mounting base with reinforcement strong enough to resist cooling tower movement during a seismic event when cooling tower is anchored to field support structure.

C. Cooling tower designed to resist wind load of 30 lbf/sq. ft.

D. Casing and Frame:

2. Fasteners: Galvanized or stainless steel to match casing and frame.

E. Collection Basin:
2. Removable stainless-steel strainer with openings smaller than nozzle orifices.
3. Overflow and drain connections.
6. Removable equalization flume plate between adjacent cells (for multiple-cell towers).
7. Equalizer connection for field-installed equalizer piping location and size as indicated on drawings (for multiple-cooling-tower systems).

F. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.

G. Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve:
   1. Enclosures: NEMA 250, Type 4X.
   2. Sensor: Solid-state controls with multiple electrode probes and relays factory wired to a terminal strip to provide control of water makeup valve, low- and high-level alarms
   4. Water Stilling Chamber: Corrosion-resistant material.
   5. Solenoid Valve: Slow closing with stainless-steel body, controlled and powered through level controller in response to water-level set point.
   6. Electrical Connection Requirements: 120 V, single phase, 60 Hz.

H. Gravity Water Distribution Basin: Nonpressurized design with head of water level in basin adequate to overcome spray nozzle losses and designed to evenly distribute water over fill throughout the flow range indicated.
   2. Location: Over each bank of fill with easily replaceable plastic spray nozzles mounted in bottom of basin.
   5. Removable Panels: Same material as basin to completely cover top of basin. Secure panels to basin with removable corrosion-resistant hardware.
   6. Single-Inlet, Field Pipe Connection: Galvanized-steel or PVC pipe arranged to provide balancing of flow within cooling tower cell without the need for additional balancing valves. Pipe each cooling tower cell internally to a single, field connection suitable for mating to ASME B16.5, Class 150 flange and located on the bottom or side unless otherwise indicated.

I. Fill:
   1. Materials: PVC, with maximum flame-spread index of 5 according to ASTM E 84.
   2. Fabrication: Fill-type sheets, fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer.
3. Fill Material Operating Temperature: Suitable for entering-water temperatures up through 120 deg F.

J. Drift Eliminator:
   1. Material: PVC; with maximum flame-spread index of 5 according to ASTM E 84.
   2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
   3. Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.

K. Air-Intake Louvers:
   1. Material: FRP, PVC, or stainless steel.
   2. UV Treatment: Inhibitors to protect FRP or PVC louvers against damage caused by UV radiation.
   3. Louver Blades: Arranged to uniformly direct air into cooling tower, to block sunlight in basin, to minimize air resistance, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.

L. Axial Fan: Balanced at the factory after assembly.
   4. Fan Shaft Bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of 50,000 hours.
   5. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.

M. Gear Drive: Right angle, reduced speed, and designed for cooling tower applications according to CTI STD 111. Motor and gear drive shall be aligned before shipment.
   1. Gear Drive and Coupling Service Factor: 2.0 based on motor nameplate horsepower.
   2. Housing: Cast iron, with epoxy or polyurethane finish, beveled high-strength steel gears continuously bathed in oil, and with lubrication to other internal parts at all operating speeds.
   3. Mounting: Directly mounted to fan hub and connected to motor so motor shaft is in horizontal position.
   4. Operation: Able to operate both forward and in reverse.
   5. Drive-to-Motor Connection: Close coupled to motor using a flexible coupling or connected to motor located outside of cooling tower casing by a full-floating drive shaft.
   6. Drive Shaft Material: Corrosion resistant or Stainless steel, and fitted with flexible couplings on both ends. Provide exposed shaft and couplings with guards according to OSHA regulations.
7. Extend oil fill, drain, and vent to outside of cooling tower casing using galvanized-steel piping. Provide installation with oil-level sight glass.

N. Fan Motor:

1. General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Division 15 Section "Common Motor Requirements for HVAC Equipment" and not indicated below.
5. Insulation: Class H.

O. Fan Discharge Stack: Material shall match casing, manufacturer’s standard velocity recovery design.

1. Stack Termination: Wire-mesh, galvanized-steel screens; complying with OSHA regulations.

P. Vibration Switch: For each fan drive.

1. Enclosure: NEMA 250, Type 4X.
2. Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
3. Provide switch with manual-reset button for field connection to a BMS and hardwired connection to fan motor electrical circuit.
4. Switch shall, on sensing excessive vibration, signal an alarm through the BMS and shut down the fan.

Q. Controls: Comply with requirements in Division 15 Section "HVAC Control System."

R. Personnel Access Components:

1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.
2. External Ladders with Safety Cages: Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.
3. External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.
4. Handrail: Aluminum, galvanized steel, or stainless steel complete with kneerail and toeboard, around top of cooling tower to safeguard personnel while accessing components located on top of cooling tower. Comply with 29 CFR 1910.23.

5. Internal Platforms: Aluminum, or galvanized-steel bar grating.
   a. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall be elevated so that all parts are above the high water level of the collection basin.
   b. Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach from collection basin platform.

2.2 SOURCE QUALITY CONTROL

A. Factory pressure test heat exchangers after fabrication and prove to be free of leaks.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cooling towers on support structure indicated.

B. Equipment Mounting: Install cooling tower on concrete base using elastomeric pads in the absence of instructions on the drawings. Comply with requirements for concrete base in Division 3. Comply with requirements for vibration isolation devices specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

   1. Minimum Deflection: see drawings.
   2. Provide stainless-steel plate to equally distribute weight over elastomeric pad.
   3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

C. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.
3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to cooling towers to allow service and maintenance.

C. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.

D. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

E. Connect cooling tower overflows and drains, and piping drains to nearest floor sink or other location as indicated on Drawings.

F. Domestic Water Piping: Comply with applicable requirements in Division 15 Section "Domestic Water Piping." Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.

G. Condenser-Water Supply and Return Piping: Comply with applicable requirements in Division 15 Section "Hydronic Piping." Connect to entering cooling tower connections with shutoff valve, balancing or flow control valve, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a union or flange.

H. Equalizer Piping: Piping requirements to match supply and return piping. Connect an equalizer pipe, full size of cooling tower connection, between tower cells. Connect to cooling tower with shutoff valve.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Where field-assembly of major sections is required engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to perform startup service.

3.4 STARTUP SERVICE

A. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

B. Obtain performance data from manufacturer.
1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

   a. Clean entire unit including basins.
   b. Verify that accessories are properly installed.
   c. Verify clearances for airflow and for cooling tower servicing.
   d. Check for vibration isolation and structural support.
   e. Lubricate bearings.
   f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
   g. Adjust belts to proper alignment and tension.
   h. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
   j. Check vibration switch setting. Verify operation.
   k. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
   l. Verify operation of basin heater and control.
   m. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
   n. Replace defective and malfunctioning units.

C. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

D. Prepare a written startup report that records the results of tests and inspections.

3.5 ADJUSTING

   A. Set and balance water flow to each tower inlet.

   B. Adjust water-level control for proper operating level.

3.6 TRAINING

   A. Train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.

END OF SECTION